

Indoor Air Quality

Model Program

**New Jersey Department of Health and Senior Services
Public Employees Occupational Safety and Health Program
P.O. Box 360
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INDOOR AIR QUALITY MODEL PROGRAM

Introduction

The Public Employees Occupational Health and Safety (PEOSH) Program has developed this Indoor Air Quality (IAQ) Model Program to help public employers and employees to understand and comply with the Indoor Air Quality Standard (N.J.A.C.12:100-13) which became effective on March 3, 1997. The IAQ Model Program includes an information bulletin on the PEOSH Indoor Air Quality Standard, a copy of the standard, information on carbon dioxide, sample IAQ forms, indoor air quality resources and detailed information on how to maintain good indoor air quality.

Employers can use the sample IAQ forms to conduct complaint investigations, interview building occupants, prepare heating, ventilation and air conditioning checklists and conduct chemical inventories. If you have any questions or comments about the information in this model program, please contact the PEOSH Program at (609) 984-1863.

INDOOR AIR QUALITY MODEL PROGRAM

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Public Employees Occupational Safety and Health (PEOSH) Program

PEOSH Indoor Air Quality Standard

Division of Environmental and Occupational Health Services

April, 1997

12:100-13.3 Compliance Program

What steps should the employer take in order to be in compliance with the Public Employees Occupational Safety and Health (PEOSH) Indoor Air Quality (IAQ) Standard?

- Identify a designated person who is responsible for taking necessary measures to assure compliance with this standard.
- The designated person is responsible for establishing and following a preventive maintenance schedule that is in accordance with the manufacturer's recommendations or with accepted practice for the heating ventilation and air conditioning system (HVAC).
- Use general or local exhaust ventilation when housekeeping and maintenance activities release hazardous chemicals or dusts at levels above the applicable permissible exposure limit (PEL) as adopted by reference under N.J.A.C. 12:100-4.2, to employees working in the building.
- When the carbon dioxide level exceeds 1,000 parts per million (ppm), the employer must check that the HVAC system is operating properly. If it is not, then follow steps outlined in 12:100-13.3(a). Carbon dioxide concentrations above 1,000 ppm may indicate ventilation problems. Please refer to **Appendix A, Carbon Dioxide as an Indicator of**

Ventilation for more information on how to measure carbon dioxide and using the results to determine problem areas.

- Check to make sure the HVAC system is in proper operating order when temperatures in office buildings are outside the guidelines of 68 to 79 degrees Fahrenheit. If the temperature is out of the guideline range, then the following steps outlined in 12:100-13.3(a)1 must be taken.
- Eliminate sources of contamination from the make-up air supply or relocate make-up air supply inlets if contamination is documented.
- Maintain the availability of natural ventilation in buildings without mechanical ventilation.
- Investigate promptly all employee complaints associated with building-related illness.

12:100-13.4 Controls of specific contaminant sources

When an employer establishes a designated smoking area, what activities is he responsible for?

(A) Tobacco smoke

- Permit smoking only in the designated area.

- Designate smoking areas which are enclosed, exhausted directly to the outside, and are kept under negative pressure with respect to the surrounding spaces to contain the smoke.
- Do not allow smoking in this area during cleaning and maintenance activities.
- Assure that employees are not required to enter designated smoking areas as part of their normal work activities.
- Post signs clearly indicating areas that are designated smoking areas.
- Post signs clearly informing anyone entering the workplace that smoking is restricted to designated areas.
- Do not allow smoking in the designated areas whenever the exhaust ventilation system is not operating properly.

When general ventilation is inadequate to control air contaminants, what is the employer responsible for?

(B) Other indoor air contaminants

- Use local exhaust ventilation or substitutes to control air contaminants when general ventilation is not adequate.

What is the employer responsible for when there is a water leak in a building?

(C) Microbial contamination

- Repair as soon as possible water leaks or dry, replace, remove or clean damp or wet materials in order to control microbial contamination.
- Remove visible microbial contamination in ductwork, humidifiers, other HVAC and building system components, or on building surfaces, such as carpeting and ceiling tiles.

12:100-13.5 Air quality during renovation and remodeling

When remodeling and renovation work is being conducted, what controls is the employer responsible for implementing?

- Use local ventilation or other protective devices

to ensure the safety of employees when renovation work and/or new construction that results in the dispersion of dust, stone and other small particles, toxic gases or other harmful substances in quantities hazardous to health.

- Isolate renovation areas in occupied buildings so that dust and debris will be confined to the renovation/construction area.
- Check product labels or seek and obtain information from manufacturers, to determine if the product contains volatile organic compounds such as solvents, formaldehyde or isocyanates that could be emitted during regular use. This is especially important before using paints, adhesives, sealants, solvents, or installation of insulation, particle board, plywood, floor coverings, carpet backing, textiles, or other materials in the course of renovation or construction.
- Use the information above to select products and to determine necessary measures to be taken to comply with this section.
- Notify employees at least 24 hours in advance, or promptly in emergency situations, of work to be performed on the building that may introduce air contaminants into their work area.

12:100-13.6 Record keeping

What type of records are necessary?

- Update the maintenance schedule to show all maintenance performed on the building.
- Include the date that such maintenance was performed and the name of the person or company performing the work.
- Retain these records for at least three (3) years and make the records available on request to employees and employee representatives and New Jersey Department of Health and Senior Services, PEOSH Program (Department) representatives for examination and copying.

12:100-13.7 Employer's response to a signed complaint

How should the employer respond to an employee signed complaint?

- Respond in writing to the Department within fifteen (15) days of receipt of the complaint notification. The response may include any combination of the following:
 - * A statement that the complaint is unfounded;
 - * A description of any remedial action already taken;
 - * An outline of any remedial measures planned but not yet taken with a timetable for completion; and/or
 - * A statement that a study of the problem, with a timetable for completion of the study, has been initiated.
- Complete remedial measures as soon as possible or initiate a study.
- Submit to the Department a written report describing the remedial measures implemented and/or a copy of a study's report within fifteen (15) working days of completion. Obtain permits for remedial work as required by NJAC 5:23-1.1 et seq. (The New Jersey Uniform Construction Code).

Activities and System Operation, HVAC Checklist, and Pollutant Pathway Forms.

What resources are available?

Questions and concerns about indoor air problems can frequently be answered by the PEOSH Program. A staff person is available every work day to answer questions. Please call (609) 984-1863.

Several federal agencies may also provide valuable information on indoor air quality. A list of these agencies is found in **Appendix C**.

To gain a better understanding of how to maintain good indoor air quality, read **Appendix D, Managing Buildings for Good IAQ**.

This information bulletin provides an overview of the New Jersey PEOSH Indoor Air Quality Standard. Consult the standard itself for complete information.

12:100-13.8 Indoor air quality (IAQ) compliance documents

What IAQ compliance documents does the employer have to provide?

- Provide, if available and requested by the Department, any of the following documents:
 - * As-built construction documents;
 - * HVAC system commissioning reports;
 - * HVAC systems testing, adjusting and balancing reports;
 - * Operations and maintenance manuals;
 - * Water treatment logs; and
 - * Operator training materials.

Are there any indoor air quality forms available that can be used?

Several forms are available for documentation and **Appendix B** contains the following forms for your use: IAQ Management Checklist, Pollutant Pathway Record for IAQ Profiles, Zone/Room Record, Ventilation Worksheet, IAQ Complaint Form, Incident Log, Occupant Interview, Occupant Diary, Log of

**PEOSH PROGRAM
READER RESPONSE CARD**

PEOSH Indoor Air Quality Standard

Dear Reader:

Please take a few minutes to help us evaluate this publication. Please check the following:

Check the category that best describes your position:

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Check the category that best describes your workplace:

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How will you use this information (check all that apply):

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| <input type="checkbox"/> assist in research | <input type="checkbox"/> in training | _____ |
| <input type="checkbox"/> change training curriculum | | _____ |

Which section did you find most useful?

The least useful and why?

Other occupational health topics you would like to see the PEOSH Program develop an information bulletin on.

Other comments and suggestions.

Cut here, fold in thirds, tape.



LABOR (a)

LABOR STANDARDS AND SAFETY ENFORCEMENT Indoor Air Quality (IAQ) Standard Adopted New Rules: N.J.A.C. 12:100-13

Proposed: October 21, 1996 at 28 N.J.R. 4564(a).

Adopted: February 6, 1997 by Mel Gelade, Acting
Commissioner, Department of Labor.

Filed: February 6, 1997 as R.1997 d.109, with
substantive and technical changes not requiring
additional public notice and comment (see N.J.A.C. 1:30-
4.3).

Authority: N.J.S.A. 34:16-27, 34:1-20, 34:1A-3 and
34:16-20 et seq., 29 U.S.C. Sections §§701 et seq., and
34 C.F.R. 361.1 et seq.

Effective Date: March 3, 1997.

Expiration Date: August 26, 1999.

Summary of Hearing Officer's Report and Agency Responses:

A public hearing on the proposed new rules was held on November 6, 1996 at the Department of Labor, John Fitch Plaza, Trenton, New Jersey. Deirdre L. Webster, Regulatory Officer, was available to preside at the hearing and to receive testimony. One individual appeared and gave testimony on the proposed new rules. As a result of the written and oral comments received, the hearing officer recommended that the rules be adopted with changes not in violation of N.J.A.C. 1:30-4.3. The public hearing record may be reviewed by contacting Deirdre L. Webster, Regulatory Officer, Office of Regulatory Services, Office of the Commissioner, Department of Labor, CN 110, Trenton, New Jersey 08625-0110. It is noted that the Public Employee Occupational Safety and Health (PEOSH) Advisory Board supports the adoption of these rules.

Summary of Agency-Initiated Changes:

Upon review of the proposed new rules as published, the Department found a typographical error in the definition of HVAC system at N.J.A.C. 12:100-13.2. The quotation marks around the word "HVAC" should include the word "system." This correction is being made on adoption.

Summary of Public Comments and Agency Responses:

Written and oral comments were received from Katherine A. Black, Staff Representative, CWA Local 1034; Thomas P. Canzanella, First Vice President, Professional Fire Fighters Association of New Jersey; M. Douglas Mueller, CIH Program Director, Environmental Resources Management, Inc.; Anthony D. Pellegrino, Manager, Bureau of Safety, New Jersey Department of Transportation; Thomas W. Peter, Industrial Hygienist, Environmental Resource; Stephen Vreeland, Chairman, New Jersey State Firemen's Mutual Benevolent Association and New Jersey State Fire Commission.

COMMENT: The Professional Firefighters Association of New Jersey supports enactment with the inclusion of additional specific language requiring the abatement of products of combustion, that is, motor vehicle exhaust from fire apparatus from within fire stations.

RESPONSE: The Department believes that the addition of this requirement would exceed the provisions previously contained in the Department of Community Affairs (DCA) IAQ rules. However, the Department encourages the commenter to make a proposal to the PEOSH Advisory Board regarding this issue for a proposed amendment to the Firefighter Standard.

COMMENT: This proposed standard only regulates public employees under PEOSH. Would it not make sense to apply this standard, when appropriately revised, to all public and private facilities, similar to the proposed U.S. Environmental Protection Agency (EPA) IAQ standard, thus providing similar safeguards for all workers?

RESPONSE: The New Jersey Public Employees Occupational Safety and Health Act, N.J.S.A. 34:6A-25 et seq., does not extend coverage to the private sector. Federal Occupational Safety and Health Act (OSHA) regulates the private sector in New Jersey.

COMMENT: The proposed new rules apply to "existing buildings occupied by public employees . . ." but does not include a de minimus cutoff as to the minimum number of public employees present in a facility. For example, if a large commercial facility leased primarily to private companies contains a small office occupied by public employees, does the entire facility then have to comply with the standard? And if so, then who would the "designated person" be if the facility is privately operated with only a very minimum occupancy by public employees?

RESPONSE: The public employer is responsible for their employees only. If a public employer leases a portion of a building, then the employer must work with the building owner regarding compliance with the provisions of the IAQ rules. It is up to each public employer to appoint a "designated person" to represent them.

COMMENT: Training requirements are not established for the "designated person" to assure that he or she is familiar with the intent of the rules and the issues associated with adverse indoor air quality.

RESPONSE: Training requirements are not mandated in the proposed IAQ rules for the "designated person." The Department recognizes that familiarity with the IAQ rules and IAQ issues are important. As a result, the Department of Health & Senior Services (DHSS) will conduct educational seminars, provide consultation, and disseminate educational materials for "designated persons" and other employer and employee representatives.

COMMENT: In N.J.A.C. 12:100-13.3, Compliance program, certain trigger limits are noted for CO₂, (1,000 ppm) and temperature (68 to 79 degrees Fahrenheit), and that if these are not complied with then the "designated person" must "check to see if the Heating Ventilation and Air Conditioning (HVAC) system is in the proper operating order." It is certainly possible, based on building layout, ventilation system supply and return locations, recent renovations adding or deleting partitions and demising walls, that areas could exist where the temperature or carbon dioxide trigger levels are exceeded, but the HVAC system is "in proper operating order." This may lead to IAQ concerns with no regulatory remedy.

RESPONSE: There may be instances where the HVAC system is operating as it should and the CO₂ levels exceed 1,000 parts per million (ppm) and the temperature reading are outside the range of 68 to 79 degrees Fahrenheit. In these instances, if a complaint is received, the Department may issue recommendations, but will not issue an Order to Comply. It was not the intent of the rule to regulate the interior building layout and design.

COMMENT: Also, N.J.A.C. 12:100-13.3, Compliance program, indicates that general or local exhaust ventilation may be needed if housekeeping or maintenance activities use hazardous

materials that may cause exposures "above the applicable Permissible Exposure Limit (PEL)." Certainly in an office environment, as opposed to a manufacturing environment, the strict adherence to the use of PELs as a trigger level for additional ventilation will not lead to "fewer complaints from employees regarding the quality of indoor air" and a "healthier workplace which will help improve employee health and productivity." Why not? Simply because "warning signs" of the presence of a typical airborne contaminants in a typical office environment, such as odor, can elicit complaints at levels well below the PEL. Perhaps the triggers should be based on more subjective concerns such as adverse odor or irritation. As an example, many reduced sulfur compounds have odor thresholds in the parts per billion range as opposed to their PELs in the parts per million range.

RESPONSE: The Department maintains the enforcement of the PELs to protect public employees exposed to toxic and hazardous substances in the workplace. If employee complaints are triggered by lower odor thresholds, then action, when appropriate, can be taken by the employer or by the Department once a complaint is filed.

COMMENT: In the Summary, it is indicated that the standard will apply to buildings occupied by public employees during their regular working hours." Such a statement is unacceptable in a business environment where building maintenance may designate regular working hours of 7:00 A.M. to 5:30 P.M., but building occupants may be expected to work varied work hours. This is especially true in a multi-use facility where numerous tenants, some public and some private, have their own work regimen.

RESPONSE: The rules apply to public employees during the regular working hours. The public employer must ensure compliance with provisions of the IAQ rules during regular working hours of all public employees in the building.

Each public employer is responsible to determine what the regular work hours are for their employees even in a situation where an employee may set his or her own hours. Since regular working hours are alterable, the employer must work with the building owner to ensure compliance with provisions of the IAQ rule for their employees.

COMMENT: Define HVAC system commissioning report referenced in N.J.A.C. 12:100-13.8(a)2.

RESPONSE: An HVAC system commissioning report is a document normally prepared by an architect or engineer that provides verification that the HVAC system is operating in conformity with the design intent. To clarify N.J.A.C. 12:100-13.8(a), the Department is adding this definition to N.J.A.C. 12:100-13.2 upon adoption. The American Society of Heating, Refrigeration, and Air Conditioning Engineering, Inc. (ASHRAE) Guideline 1-1989 has more information on this subject.

COMMENT: Be more specific and define office buildings, referenced in N.J.A.C. 12:100-13.3(a)4, for example, an office within a repair shop should be excluded from the temperature compliance program. Radiant heaters may be used to make a person "feel" warmer while the air itself is not heated. A dry bulb temperature reading of the air would give a false indication of the employee comfort level.

RESPONSE: The Department interprets an office building as being a building in which administrative and/or clerical activities are conducted. Examples of some facilities and/or operations it does not consider as an office building include schools, repair shops, garages, and print shops. To clarify N.J.A.C. 12:100-13.3(a)4, the definition of "office building" has been added to N.J.A.C. 12:100-13.2 upon adoption.

COMMENT: Clarify and reword the type of inspection under N.J.A.C. 12:100-13.3(a)1. "Additionally, any reservoirs or parts of this system ... shall be checked visually for microbial growth."

RESPONSE: The word "visually" was inserted at N.J.A.C. 12:100-13.3(a)1 to clarify that the check for microbial growth is a visual check and not a lab test. The Department never intended this check to be otherwise and based on the commenter's statement recognized that this intent was not clearly understood as a rule was drafted. As a result, this clarification has been made on adoption.

COMMENT: All too often, indoor air quality complaints are described as "building-related illnesses." N.J.A.C. 12:100-13.3(a)7 should be reworded as "Promptly investigating all employee complaints of signs or symptoms that are medically determined to be associated with buildings-related illnesses."

RESPONSE: Building-related illnesses, as defined under N.J.A.C.12:100-13.2, describes specific medical conditions of known etiology which can be documented by physical signs and laboratory findings. Examples of several illnesses are listed in the definition.

COMMENTS: As a suggestion, your program may need to go into more detail on how to control microbial growth by:

1) **Filtration:** Preventing biological contaminants and organic nutrients from entering the building by means of high filtration (use high efficiency filters inside the HVAC systems).

2) **Humidity:** Maintaining a low humidity, dry surfaces in HVAC system, and prevent flooding, roof leaks, and condensation (inspections to identify structural and engineering flaws that may contribute to the humidity).

3) **Ventilation:** Provide adequate ventilation, following ASHRAE's Guidelines for minimum ventilation rates (filtration of recirculated air would also aid in controlling microbial growth).

4) **Housekeeping:** Good housekeeping to minimize soil and organic matter, using high efficiency filter bags in vacuum cleaners, minimize the use of carpets in high soil/moisture areas.

RESPONSE: The Department agrees with the comments and notes that the commenter's recommendations are already addressed in the rules as follows:

Filtration - Some filters in HVAC systems are not efficient enough to remove small (one to two microns) fungal and bacterial spores. In order to remove fungal and bacterial spores, filters should have a 50 to 70 percent efficiency rating. The Department is not mandating the use of filters with the higher efficiency rating due to increased cost to employers but will encourage their use when appropriate and economically feasible.

Humidity - N.J.A.C. 12:100-13.4(c) has provisions that require the employer to promptly repair water leaks that can promote growth of biological agents or that the employer control microbial contamination by promptly drying, replacing, removing or cleaning damp or wet materials. In addition, the employer must take measures to remove visible microbial contamination in ductwork, humidifiers, other HVAC and building systems as well as other surfaces in the building.

Ventilation - Adequate fresh air is needed to dilute human-source bioaerosols. The proposed standard does not require retrofitting of existing ventilation systems but rather ensures that the employer check to make sure that the existing HVAC system is operating as it should when the carbon dioxide levels exceed 1,000 ppm (see N.J.A.C. 12:100-13.3(a)3).

Housekeeping - The Department enforces housekeeping provisions under the Sanitation Standard (29 C.F.R. 1910.141).

COMMENT: The key to the promulgation of any of the indoor air quality rules, that is, New Jersey's and OSHA's, is acceptance by the building owners and managers. They feel that these programs will burden them financially. Your program through the proper education (presentations by PEOSH) would help them understand the cost-benefit relationship of managing indoor air quality. In your proposed rules, you should mention that there will be assistance by PEOSH to get them started, PEOSH's program should be publicized as a friend to the building owners and managers.

RESPONSE: The Department agrees that education is a key component to the acceptance of the IAQ rules. The DHSS is currently preparing an IAQ packet which will summarize the IAQ rules and provide detailed information and checklists to assist employers and

employees in maintaining acceptable indoor air quality in the workplace. In addition, the DHSS provides consultative services and educational seminars regarding IAQ on a routine basis for employer and employee groups.

COMMENT: We recommend that in N.J.A.C. 12:100-13.7(b), the final sentence should read: "the employer shall implement other control measures such as local source capture exhaust ventilation." Remove substitution from the end.

RESPONSE: When possible, substitution of less hazardous process or chemicals is an acceptable method to reduce potential health effects among employees. In some instances, substitution may negate the need to provide local exhaust ventilation.

COMMENT: Several commenters voiced support for the proposed IAQ rules.

RESPONSE: The Department appreciates the notes of support.

FEDERAL STANDARDS STATEMENT

There are no Federal standards or requirements concerning indoor air quality. As a result, these rules do not exceed standards or requirements imposed by Federal law. A Federal exceedance analysis is, therefore, not required.

Full text of the adoption follows (additions to proposal indicated in boldface with asterisks ***thus***; deletions from proposal indicated in brackets with asterisks ***[thus]***):

SUBCHAPTER 13. INDOOR AIR QUALITY STANDARD

12:100-13.1 Scope

This subchapter shall apply to matters relating to indoor air quality in existing buildings occupied by public employees during their regular work hours.

12:100-13.2 Definitions

The following words and terms, when used in this subchapter, have the following meaning unless the context clearly indicates otherwise.

"Air contaminants" refers to substances contained in the vapors from paint, cleaning chemicals, pesticides, solvents, particulates, outdoor air pollutants and other airborne substances which together may cause material impairment to employees working within the enclosed workplace.

"Building-related illness" describes specific medical conditions of known etiology which can be documented by physical signs and laboratory findings. Such illnesses include sensory irritation when caused by known agents, respiratory allergies, asthma, nosocomial infections, humidifier fever, Legionnaires' disease, and the signs and symptoms characteristic of exposure to chemical or biologic substances such as carbon monoxide, formaldehyde, pesticides, endotoxins, or mycotoxins.

"Building systems" includes the heating, ventilation and air-conditioning (HVAC) system, the energy management system and all other systems in a facility which may impact indoor air quality.

"Designated person" means a person who has been given the responsibility by the employer to take necessary measures to assure compliance with this subchapter.

"Department" means the Department of Health and Senior Services.

"Designated smoking area" means an area in a building, where smoking is permitted and which is physically separated from non-smoking areas and which non-smokers are not required to enter or pass through.

"Employee" means the term as defined at N.J.A.C. 12:100-2.1.

"Employer" means the term as defined at N.J.A.C. 12:100-2.1.

["HVAC"] **"HVAC system"** means the collective components of the heating, ventilation and air-conditioning system including, but not limited to, filters and frames, cooling coil condensate drip pans and drainage piping, outside air dampers and actuators, humidifiers, air distribution ductwork, automatic temperature controls, and cooling towers.

"HVAC System Commissioning Report" means a document normally prepared by an architect or engineer that provides verification that the HVAC system is operating in conformity with the design intent.*

"Office building" means a building in which administrative and/or clerical activities are conducted. Examples of facilities and/or operations which are not office buildings include schools, repair shops, garages and print shops.*

"Renovation and remodeling" means building modification involving activities that include but are not limited to: removal or replacement of walls, roofing, ceilings, floors, carpet, and components such as moldings, cabinets, doors, and windows; painting; decorating; demolition; surface refinishing; and removal or cleaning of ventilation ducts.

12:100-13.3 Compliance program

(a) The employer shall identify a designated person who is given the responsibility to assure compliance with this section. The designated person shall assure that at least the following actions are implemented and documented:

1. Establishing and following a preventive maintenance schedule in accordance with the manufacturer's recommendations or with accepted practice for the HVAC system. Scheduled maintenance of the HVAC system shall include checking and/or changing air filters, checking and/or changing belts, lubrication of equipment parts, checking the functioning of motors and confirming that all ***[equipment]*** ***equipment*** is in operating order. Damaged or inoperable components shall be replaced or repaired as appropriate. Additionally, any reservoirs or parts of this system with standing water shall be checked ***visually*** for microbial growth;

2. Implementing the use of general or local exhaust ventilation where housekeeping and maintenance activities involve use of equipment or products that could reasonably be expected to result in hazardous chemical or particulate exposures, above the applicable Permissible Exposure Limit (PEL), as adopted by reference under N.J.A.C. 12:100-4.2, to employees working in other areas of the building or facility;

3. When the carbon dioxide level exceeds 1,000 parts per million (ppm), the employer shall check to make sure the HVAC system is operating as it should. If it is not, the employer shall take necessary steps as outlined in (a)1 above;

4. When temperatures in office buildings are outside of the range of 68 to 79 degrees Fahrenheit, the employer shall check to make sure the HVAC system is in proper operating order. If it is not, the employer shall take necessary steps as outlined in (a)1 above;

5. If contamination of the make-up air supply is identified and documented, then the make-up inlets and/or exhaust air outlets shall be relocated or the source of the contamination eliminated. Sources of make-up air contamination may include contaminants from sources such as cooling towers, sanitary vents, vehicular exhausts from parking garages, loading docks, and street traffic;

6. Assuring that buildings without mechanical ventilation are maintained so that windows, doors, vents, stacks and other portals designed or used for natural ventilation are in operable condition; and
7. Promptly investigating all employee complaints of signs or symptoms that may be associated with building-related illness.

12:100-13.4 Controls of specific contaminant sources

(a) In workplaces where the employer has established designated smoking areas, the following shall apply:

1. Smoking shall be permitted only in such areas;
2. The employer shall assure that designated smoking areas are enclosed, exhausted directly to the outside, and are maintained under negative pressure (with respect to surrounding spaces) sufficient to contain tobacco smoke within the designated area;
3. The employer shall assure that cleaning and maintenance work in designated smoking areas is conducted only when no smoking is taking place;
4. The employer shall assure that employees are not required to enter designated smoking areas in the performance of normal work activities;
5. The employer shall post signs clearly indicating areas that are designated smoking areas;
6. The employer shall post signs that will clearly inform anyone entering the workplace that smoking is restricted to designated areas; and
7. The employer shall prohibit smoking within designated smoking areas during any period that the exhaust ventilation system servicing that area is not properly operating.

(b) Regarding other indoor air contaminants, when general ventilation is inadequate to control air contaminants emitted from point sources within work spaces to below the applicable PEL, as adopted by reference under N.J.A.C. 12:100-4.2, the employer shall implement other control measures such as local source capture exhaust ventilation or substitution,

(c) The employer shall control microbial contamination in the building by promptly repairing water leaks that can promote growth of biologic agents, or shall control microbial contamination in the building by promptly drying, replacing, removing, or cleaning damp or wet materials. The employer shall take measures to remove visible microbial contamination in ductwork, humidifiers, other HVAC and building system components, or on building surfaces, such as carpeting and ceiling tiles, when found during regular or emergency maintenance activities or during visual inspection.

12:100-13.5 Air quality during renovation and remodeling

(a) Renovation work and/or new construction that results in the diffusion of dust, stone and other small particles, toxic gases or other harmful substances in quantities hazardous to health shall be safeguarded by means of local ventilation or other protective devices to ensure the safety of employees. Renovation areas in occupied buildings shall be isolated and dust and debris shall be confined to the renovation or construction area.

(b) Before use of paints, adhesives, sealants, solvents, or installation of insulation, particle board, plywood, floor coverings, carpet backing, textiles, or other materials in the course of renovation or construction, the employer shall check product labels or seek and obtain information from the manufacturers of those products on whether or not they contain volatile organic compounds such as solvents, formaldehyde or isocyanates that could be emitted during regular use. This information shall be used to select products and to determine necessary measures to be taken to comply with this section.

(c) The employer shall notify employees at least 24 hours in advance, or promptly in emergency situations, of work to be performed on the building that may introduce air contaminants into their work area.

12:100-13.6 Recordkeeping

(a) The maintenance schedule shall be updated to show all maintenance performed on the building systems. The schedule shall include the date that such maintenance was performed and the name of the person or company performing the work.

(b) The records required to be maintained by this section shall be retained for at least three years and be available on request to employees and employee representatives and Department representatives for examination and copying.

12:100-13.7 Employer's response to a signed complaint

(a) Within 15 working days of receipt of the complaint notification from the Department, the employer shall respond in writing to the Department. The response may include any combination of the following:

1. A statement that the complaint is unfounded;
2. A description of any remedial action already taken;
3. An outline of any remedial measures planned but not yet taken with timetable for completion; and/or
4. A statement that a study of the problem, with a timetable for completion of the study, has been initiated.

(b) Where remedial measures are planned or a study initiated, they shall be completed as soon as feasible. The employer shall submit, to the Department, a written report describing the remedial measures implemented and/or a copy of a study's report within 15 working days of completion.

(c) Permits for remedial work shall be obtained as required by N.J.A.C. 5:23 (the New Jersey Uniform Construction Code). All work requiring a permit shall be performed in compliance with N.J.A.C. 5:23.

12:100-13.8 Indoor air quality (IAQ) compliance documents

(a) In response to an employee complaint to the Department, the employer shall provide any of the following documents, if available, and requested by the Department:

1. As-built construction documents;
2. HVAC system commissioning reports;
3. HVAC systems testing, adjusting and balancing reports;
4. Operations and maintenance manuals;
5. Water treatment logs; and
6. Operator training materials.



Public Employees Occupational Safety and Health (PEOSH) Program

Appendix A: Carbon Dioxide (CO₂)

Division of Environmental and Occupational Health Services

April, 1997

Carbon dioxide (CO₂) is a normal constituent of the atmosphere. Exhaled breath from building occupants is an important indoor CO₂ source. Indoor CO₂ concentrations can, under some test conditions, provide a good indication of the adequacy of ventilation. Comparison of peak CO₂ readings between rooms, between air handler zones, and at varying heights above the floor, may help to identify and diagnose various building ventilation deficiencies.

Methodology

Carbon dioxide can be measured with either a direct-reading meter or a detector tube kit. The relative occupancy, air damper settings, and weather should be noted for each period of CO₂ testing.

Carbon dioxide measurements for ventilation should be collected away from any source that could directly influence the reading (e.g., hold the sampling device away from exhaled breath). Individual measurements should be short-term. As with many other measurements of indoor air conditions, it is advisable to take one or more readings in "control" locations to serve as baselines for comparison. Readings from outdoors and from areas in which there are no apparent indoor air quality problems are frequently used as controls. Outdoor samples should be taken near the outdoor air intake.

Measurements taken to evaluate the adequacy of ventilation should be made when concentrations are expected to peak. It may be helpful to compare measurements taken at different times of day. If the occupant population is fairly stable during normal business hours, CO₂ levels will typically rise during the morning, fall during the lunch period, then rise again, reaching a peak in mid-afternoon. In this case, sampling in the mid-to late-afternoon is recommended. Other sampling times may be necessary for different occupancy schedules.

Using the Results

Peak CO₂ concentrations above 1,000 ppm indicate ventilation problems. Carbon dioxide concentrations below 1,000 ppm generally indicate that ventilation is adequate to deal with the routine products of human occupancy. However, there are several reasons not to conclude too quickly that low CO₂ reading means no IAQ problems exists. Problems can occur in buildings in which measured CO₂ concentrations are below 1,000 ppm. Although CO₂ readings indicate good ventilation, for example, if strong containment sources are present, some sort of source control may be needed to prevent IAQ problems. Errors in measurement and varying CO₂ concentrations over time can also cause low readings that may be misleading.

Elevated CO₂ may be due to various causes along in or combination, such as: increased occupant population, air exchange rates below ASHRAE guidelines, poor air distribution, and poor air mixing. A higher average CO₂ concentration in the general breathing zone (at least two feet from exhaled breath) than in the air entering return grilles is an indication of poor air mixing. Smoke tubes and temperature profiles will help to clarify air circulation patterns.

If CO₂ measurements taken before the occupied period begins are higher than out-door readings taken at the same time, there may be an operating problem with the HVAC

system. Potential problems include the following:

- ventilation terminated too early the evening before (as compared with the occupancy load in the space)
- combustion by-products from a nearby roadway or parking garage are drawn into the building
- a gas-fired heating appliance in the building has a cracked heat exchanger

The information in this document has been reprinted from EPA document # ISBN 0-16-035918-8, Building Air Quality, A Guide for Building Owners and Facility Managers.



Public Employees Occupational Safety and Health (PEOSH) Program

Appendix B: Indoor Air Quality Forms

Division of Environmental and Occupational Health Services

April, 1997

This section of the document is a collection of the forms that appear or are mentioned in the text. Consider making copies of the forms, blocking out the page information at the bottom of the copies, and then reproducing these copies for use in your building. Some or all of them may require adaption to meet your specific needs. Blank formatted sheets are included for preparing your own HVAC Checklist and Pollutant and Source Inventory.

The forms appear in the following sequence:

IAQ Management Checklist (4 pages): for keeping track of the elements of the IAQ profile and IAQ management plan.

Pollutant Pathway Record for IAQ Profiles: for identifying areas in which negative or positive pressure should be maintained.

IAQ Complaint Form: to be filled out by the complainant or by a staff person who receives information from the complainant.

Incident Log: for keeping track of each IAQ complaint or problem and how it is handled.

Occupant Interview (2 pages): for recording the observations of building occupants in relation to their symptoms and conditions in the building.

Occupant Diary: for recording incidents of symptoms and associated observations as they occur.

Log of Activities and System Operation: for recording activities and equipment operating schedules as they occur.

HVAC Checklist - Short Form (4 pages): to be used as a short form for investigating an IAQ problem, or for periodic inspections of the HVAC system. Duplicate pages 2 through 4 for each large air handling unit.

Pollutant Pathway Form For Investigations: To be used in conjunction with a floor plan of the building.

Pollutant and Source Inventory (6 pages, followed by one blank formatted sheet): to be used as a general checklist of potential indoor and outdoor pollutant sources.

Chemical Inventory: for recording information about chemicals stored or used within the building.

Hypothesis Form: to be used for summarizing what has been learned during the building investigation; a tool to help the investigator collect his or her thoughts.

The information in this document has been re-printed from EPA document # 15BN 0-16-035918-8; Building Air Quality, A Guide for Building Owners and Facility Managers.

IAQ MANAGEMENT CHECKLIST

Building Name: _____ Date: _____

Address: _____

Completed by (name/title): _____

Item	Date Begun or Completed (as applicable)	Responsible Person (name, telephone)	Location ("NA" if the item is not applicable to this building)
------	--	---	---

IAQ PROFILE

Collect and Review Existing Records

HVAC design data, operating instructions, and manuals			
HVAC maintenance and calibration records, testing and balancing reports			
Inventory of locations where occupancy, equipment, or building use has changed			
Inventory of complaint locations			

Conduct a Walkthrough Inspection of the Building

List of responsible staff and/or contractors, evidence of training, and job descriptions			
Identification of areas where positive or negative pressure should be maintained			
Record of locations that need monitoring or correction			

Collect Detailed Information

Inventory of HVAC system components needing repair, adjustment, or replacement			
Record of control settings and operating schedules			

IAQ MANAGEMENT CHECKLIST

Item	Date Begun or Completed (as applicable)	Responsible Person (name, telephone)	Location ("NA" if the item is not applicable to this building)
Plan showing air flow directions or pressure differentials in significant areas			
Inventory of significant pollutant sources and their locations			
MSDSs for supplies and hazardous substances that are stored or used in the building			
Zone/Room Record			

IAQ MANAGEMENT PLAN

Select IAQ Manager			
Review IAQ Profile			

Assign Staff Responsibilities/Train Staff

Facilities Operation and Maintenance			
■ confirm that equipment operating schedules are appropriate			
■ confirm appropriate pressure relationships between building usage areas			
■ compare ventilation quantities to design, codes, and ASHRAE 62-1989			
■ schedule equipment inspections per preventive maintenance plan or recommended maintenance schedule			
■ modify and use HVAC Checklist(s); update as equipment is added, removed, or replaced			
■ schedule maintenance activities to avoid creating IAQ problems			

IAQ MANAGEMENT CHECKLIST

Item	Date Begun or Completed (as applicable)	Responsible Person (name, telephone)	Location ("NA" if the item is not applicable to this building)
■ review MSDS's for supplies; request additional information as needed			
■ consider using alarms or other devices to signal need for HVAC maintenance (e.g., clogged filters)			

Housekeeping

■ evaluate cleaning schedules and procedures; modify if necessary			
■ review MSDSs for products in use; buy different products if necessary			
■ confirm proper use and storage of materials			
■ review trash disposal procedures; modify if necessary			

Shipping and Receiving

■ review loading dock procedures (NOTE: If air intake is located nearby, take precautions to prevent intake of exhaust fumes.)			
■ check pressure relationships around loading dock			

Pest Control

■ consider adopting integrated pest management (IPM) methods			
■ obtain and review MSDS's; review handling and storage			
■ review pest control schedules and procedures			
■ review ventilation used during pesticide application			

IAQ MANAGEMENT CHECKLIST

Item	Date Begun or Completed (as applicable)	Responsible Person (name, telephone)	Location ("NA" if the item is not applicable to this building)
Occupant Relations			
■ establish health and safety committee or joint tenant/management IAQ task force			
■ review procedures for responding to complaints; modify if necessary			
■ review lease provisions; modify if necessary			
Renovation, Redecorating, Remodeling			
■ discuss IAQ concerns with architects, engineers, contractors, and other professionals			
■ obtain MSDSs; use materials and procedures that minimize IAQ problems			
■ schedule work to minimize IAQ problems			
■ arrange ventilation to isolate work areas			
■ use installation procedures that minimize emissions from new furnishings			
Smoking			
■ eliminate smoking in the building			
■ if smoking areas are designated, provide adequate ventilation and maintain under negative pressure			
■ work with occupants to develop appropriate non-smoking policies, including implementation of smoking cessation programs			

POLLUTANT PATHWAY RECORD FOR IAQ PROFILES

This form should be used in combination with a floor plan such as a fire evacuation plan.

Building Name: _____ File Number: _____

Address: _____

Completed by: _____ Title : _____ Date: _____

Building areas that contain contaminant sources (e.g., bathrooms, food preparation areas, smoking lounges, print rooms, and art rooms) should be maintained under negative pressure relative to surrounding areas. Building areas that need to be protected from the filtration of contaminants (e.g., hallways, in multi-family dwellings, computer rooms, and lobbies) should be maintained under positive pressure relative to the outdoors and relative to surrounding areas.

List the building areas in which pressure relationships should be controlled. As you inspect the building, put a Y or N in the "Needs Attention" column to show whether the desired air pressure relationship is present. Mark the floor plan with arrows, plus signs(+) and minus signs (-) to show the airflow patterns you observe using chemical smoke or a micromanometer.

Building areas that appear isolated from each other may be connected by airflow passages such as air distribution zones, utility tunnels or chases, party walls, spaces above suspended ceilings (whether or not those spaces are serving as air plenums), elevator shafts, and crawlspaces. If you are aware of pathways connecting the room to identified pollutant sources (e.g., items of equipment, chemical storage areas, bathrooms), it may be helpful to record them in the "Comments" column, on the floor plan, or both.

Building Area (zone, room)	Use	Intended Pressure		Needs Attention? (Y / N)	Comments
		Positive (+)	Negative (-)		

INDOOR AIR QUALITY COMPLAINT FORM (for internal use only)

Occupant Name: _____ Date: _____

Department/Location in Building: _____ Phone: _____

Completed by: _____ Title: _____ Phone: _____

This form is to be used if your complaint may be related to indoor air quality. Indoor air quality problems include concerns with temperature control, ventilation, and air pollutants. Your observations can help to resolve the problem as quickly as possible. Please use the space below to describe the nature of the complaint and any potential causes.

We may need to contact you to discuss your complaint. What is the best time to reach you? _____

So that we can respond promptly, please return this form to: _____

IAQ Manager or Contact Person

Room, Building, Mail Code

OFFICE USE ONLY

File Number: _____ Received by: _____ Date Received: _____

INCIDENT LOG

Building Name: _____ Dates (from): _____ (to): _____

Address: _____ Completed by (name): _____

File Number	Date	Problem Location	Investigation Record (check the forms that were used)									Outcome/Comments (use more than one line if needed)	Log Entry By (Initials)
			Complaint Form	Occupant Interview	Occupant Diary	Log of Activities	Zone / Room Record	HVAC Checklist	Pollutant Pathway	Source Inventory	Hypothesis Form		

OCCUPANT INTERVIEW

Building Name: _____ File Number: _____

Address: _____

Occupant Name: _____ Work Location: _____

Completed by: _____ Title: _____ Date: _____

Symptom Patterns

What kind of symptoms or discomfort are you experiencing?

Are you aware of other people with similar symptoms or concerns? Yes _____ No _____

If so, what are their names and locations? _____

Do you have any health conditions that make you particularly susceptible to environmental problems?

- | | | |
|---|---|--|
| <input type="checkbox"/> contact lenses | <input type="checkbox"/> chronic cardiovascular disease | <input type="checkbox"/> undergoing chemotherapy or radiation therapy |
| <input type="checkbox"/> allergies | <input type="checkbox"/> chronic respiratory disease | <input type="checkbox"/> immune system suppressed by disease or other causes |
| | <input type="checkbox"/> chronic neurological problems | |

Timing Patterns

When did your symptoms start?

When are they generally worst?

Do they go away? If so, when?

Have you noticed any other events (such as weather events, temperature or humidity changes, or activities in the building) that tend to occur around the same time as your symptoms?

OCCUPANT INTERVIEW

Spatial Patterns

Where are you when you experience symptoms or discomfort?

Where do you spend most of your time in the building?

Additional Information

Do you have any observation about building conditions that might need attention or might help explain your symptoms (e.g., temperature, humidity, drafts, stagnant air, odors)?

Have you sought medical attention for your symptoms?

Do you have any other comments?

OCCUPANT DIARY

Occupant Name: _____ Title: _____ Date: _____

Location: _____ File Number: _____

On the form below, please record each occasion when you experience a symptom of ill health or discomfort that you think may be linked to an environmental condition in this building.

It is important that you record the time and date and your location within the building as accurately as possible, because that will help to identify conditions (e.g., equipment operation) that may be associated with your problem. Also, please try to describe the severity of your symptoms (e.g., mild, severe) and their duration (the length of time that they persist). Any other observations that you think may help in identifying the cause of the problem should be noted in the "Comments" column. Feel free to attach additional pages or use more than one line for each event if you need more room to record your observations.

Time/Date	Location	Symptom	Severity/Duration	Comments

LOG OF ACTIVITIES AND SYSTEM OPERATION

Building Name: _____ Address: _____ File Number: _____

Completed by: _____ Title: _____ Phone: _____

On the form below, please record your observations of the HVAC system operation, maintenance activities, and any other information that you think might be helpful in identifying the cause of IAQ complaints in this building. Please report any other observations (e.g., weather, other associated events) that you think may be important as well.

Feel free to attach additional pages or use more than one line for each event.

Equipment and activities of particular interest:

Air Handler(s): _____

Exhaust Fan(s): _____

Other Equipment or Activities: _____

Date/Time	Day of Week	Equipment Item/Activity	Observations/Comments

HVAC CHECKLIST - SHORT FORM

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Mechanical Room

- Clean and dry? _____ Stored refuse or chemicals? _____
- Describe items in need of attention _____

Major Mechanical Equipment

- Preventive maintenance (PM) plan in use? _____

Control System

- Type _____
- System operation _____
- Date of last calibration _____

Boiler

- Rated BTU input _____ Condition _____
- Combustion air: is there at least one square inch free per 2,000 BTU input? _____
- Fuel or combustion odors _____

Cooling Tower

- Clean? no leaks or overflow? _____ Slime or algae growth? _____
- Eliminator performance _____
- Biocide treatment working? (list type of biocide) _____
- Spill containment plan implemented? _____ Dirt separator working? _____

Chillers

- Refrigerant leaks? _____
- Evidence of condensation problems? _____
- Waste oil and refrigerant properly stored and disposed of? _____

HVAC CHECKLIST - SHORT FORM

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Air Handling Unit

- Unit identification _____ Area served _____

Outdoor Air Intake, Mixing Plenum, and Dampers

- Outdoor air intake location _____
- Nearby contaminant sources? (describe) _____
- Bird screen in place and unobstructed? _____
- Design total cfm _____ outdoor air (O.A.) cfm _____ date last tested and balanced _____
- Minimum % O.A. (damper setting) _____ Minimum cfm O.A. $\left(\frac{\text{total cfm} \times \text{maximum \% O.A.}}{100} \right) =$ _____
- Current O.A. damper setting (date, time, and HVAC operating mode) _____
- Damper control sequence (describe) _____
- Condition of dampers and controls (note date) _____

Fans

- Control sequence _____
- Condition (note date) _____
- Indicated temperatures supply air _____ mixed air _____ return air _____ outdoor air _____
- Actual temperatures supply air _____ mixed air _____ return air _____ outdoor air _____

Coils

- Heating fluid discharge temperature _____ ΔT _____ cooling fluid discharge temperature _____ ΔT _____
- Controls (describe) _____
- Condition (note date) _____

Humidifier

- Type _____ If biocide is used, note type _____
- Condition (no overflow, drains trapped, all nozzles working?) _____
- No slime, visible growth, or mineral deposits? _____

HVAC CHECKLIST - SHORT FORM

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Distribution System

Zone / Room	System Type	Supply Air		Return Air		Power Exhaust		
		Ducted / Unducted	cfm	Ducted / Unducted	cfm	cfm	Control	Serves (e.g. toilet)

Condition of distribution system and terminal equipment (note locations of problems)

- Adequate access for maintenance? _____
- Ducts and coils clean and unobstructed? _____
- Air paths unobstructed? supply _____ return _____ transfer _____ exhaust _____ make-up _____
- Note locations of blocked air paths, diffusers, or grilles _____
- Any unintentional openings into plenums? _____
- Controls operating properly? _____
- Air volume correct? _____
- Drain pans clean? Any visible growth or odors? _____

Filters

Location	Type/Rating	Size	Date Last Changed	Condition (give date)

HVAC CHECKLIST - SHORT FORM

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Occupied Space

Thermostat Types

Zone / Room	Thermostat Location	What does Thermostat Control? (E.g., radiator, AHU-3)	Setpoints		Measured Temperature	Day/Time
			Summer	Winter		

Humidistat/Dehumidistat Types

Zone / Room	Humidistat / Dehumidistat Location	What Does It Control?	Setpoints (% RH)	Measured Temperature	Day/Time

- Potential problems (note location) _____
- Thermal comfort or air circulation problems (drafts, obstructed airflow, stagnant air, overcrowding, poor thermostat location)

- Malfunctioning equipment _____
- Major sources of odors or contaminants (e.g., poor sanitation, incompatible uses of space)

POLLUTANT PATHWAY FORM FOR INVESTIGATIONS

Building Name: _____ File Number: _____

Address: _____ Completed by: _____

This form should be used in combination with a floor plan such as a fire evacuation plan.

Building areas that appear isolated from each other may be connected by airflow passages such as air distribution zones, utility tunnels or chases, party walls, spaces above suspended ceilings (whether or not those spaces are serving as air plenums), elevator shafts, and crawl spaces.

Describe the complaint area in the space below and mark it on your floor plan. Then list rooms or zones connected to the complaint area by airflow pathways. Use the form to record the direction of airflow between the complaint area and the connected rooms/zones, including the date and time. (Airflow patterns generally change over time). Mark the floor plan with arrows or plus(+) and minus (-) signs to map out the airflow patterns you observe, using chemical smoke or a micromanometer. The "Comments" column can be used to note pollutant sources that merit further attention.

Rooms or zones included in the complaint area: _____

Rooms or Zones Connected to the Complaint Area By Pathways	Use	Pressure Relative to Complaint Area		Comments (e.g., potential pollutant sources)
		+/-	Date/Time	

POLLUTANT AND SOURCE INVENTORY

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeated events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
SOURCES OUTSIDE BUILDING				
Contaminated Outdoor Air				
Pollen, dust				
Industrial contaminants				
General vehicular contaminants				
Emissions from Nearby Sources				
Vehicle exhaust (parking areas, loading docks, roads)				
Dumpsters				
Re-entrained exhaust				
Debris near outside air intake				
Soil Gas				
Radon				
Leaking underground tanks				
Sewage smells				
Pesticides				

POLLUTANT AND SOURCE INVENTORY

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeated events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
Moisture or Standing Water				
Rooftop				
Crawlspace				
EQUIPMENT				
HVAC System Equipment				
Combustion gases				
Dust, dirt, or microbial growth in ducts				
Microbial growth in drip pans, chillers, humidifiers				
Leaks or treated boiler water				
Non HVAC System Equipment				
Office Equipment				
Supplies for Equipment				
Laboratory Equipment				

POLLUTANT AND SOURCE INVENTORY

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeated events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
HUMAN ACTIVITIES				
Personal Activities				
Smoking				
Cosmetics (odors)				
Housekeeping Activities				
Cleaning materials				
Cleaning procedures (e.g., dust from sweeping, vacuuming)				
Stored supplies				
Stored refuse				
Maintenance Activities				
Use of materials with volatile compounds (e.g., paint, caulk, adhesives)				
Stored supplies with volatile compounds				
Use of pesticides				

POLLUTANT AND SOURCE INVENTORY

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeatable events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
BUILDING COMPONENTS FURNISHINGS				
Locations Associated with Dust or Fibers				
Dust-catching area (e.g., open shelving)				
Deteriorated furnishings				
Asbestos-containing materials				
Unsanitary Conditions/Water Damage				
Microbial growth in or on soiled or water-damaged furnishings				

POLLUTANT AND SOURCE INVENTORY

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeated events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
Chemicals Released from Building Components or Furnishings				
Volatile compounds				
OTHER SOURCES				
Accidental Events				
Spills (e.g., water, chemicals, beverages)				
Water leaks or flooding				
Fire damage				

POLLUTANT AND SOURCE INVENTORY

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeatd events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments
Special Use/Mixed Use Area				
Smoking lounges				
Food preparation areas				
Underground or attached parking garages				
Laboratories				
Print shops, art rooms				
Exercise rooms				
Beauty salons				
Redecorating/Repair/Remodeling				
Emissions from new furnishings				
Dust, fibers from demolition				
Odors, volatile compounds				

POLLUTANT AND SOURCE INVENTORY

Building Name: _____ Address: _____

Completed by: _____ Date: _____ File Number: _____

Using the list of potential source categories below, record any indications of contamination or suspected pollutants that may require further investigation or treatment. Sources of contamination may be constant or intermittent or may be linked to single, unrepeated events. For intermittent sources, try to indicate the time of peak activity or contaminant production, including correlations with weather (e.g., wind direction).

Source Category	Checked	Needs Attention	Location	Comments

CHEMICAL INVENTORY

Building Name: _____ File Number: _____

Address: _____

Completed by: _____ Phone: _____

The inventory should include chemicals stored or used in the building for cleaning, maintenance, operations, and pest control. If you have an MSDS (Material Safety Data Sheet) for the chemical, put a check mark in the right-hand column. If not, ask the chemical supplier to provide the MSDS, if one is available.

Date	Chemical/Brand Name	Use	Storage Location(s)	MSDS on file?

HYPOTHESIS FORM

Building Name: _____ File Number: _____

Address: _____

Completed by: _____

Complaint Area (may be revised as the investigation progresses):

Complaints (e.g., summarize patterns of timing, location, number of people affected):

HVAC: Does the ventilation system appear to provide adequate outdoor air, efficiently distributed to meet occupant needs in the complaint area? If not, what problems do you see?

Is there any apparent pattern connecting the location and timing of complaints with the HVAC system layout, condition or operating schedule?

Pathways: What pathway and driving forces connect the complaint area to locations of potential sources?

Are the flows opposite to those intended in the design? _____

Sources: What potential sources have been identified in the complaint area or in locations associated with the complaint area (connected by pathways)?

Is the pattern of complaints consistent with any of these sources? _____

HYPOTHESIS FORM

Building Name: _____ File Number: _____

Address: _____

Completed by: _____

Hypothesis: Using the information you have gathered, what is your best explanation for the problem?

Hypothesis testing: How can this hypothesis be tested?

If measurements have been taken, are the measurement results consistent with this hypothesis?

Results of Hypothesis Testing:

Additional Information Needed:



Public Employees Occupational Safety and Health (PEOSH) Program

Appendix C: Indoor Air Quality Resources

Division of Environmental and Occupational Health Services

April, 1997

STATE AGENCY WITH MAJOR INDOOR RESPONSIBILITIES FOR PUBLIC BUILDINGS

Public Employees Occupational Safety and Health (PEOSH) Program

PO Box 360
Trenton, NJ 08625-0360
(609) 984-1863

Promulgates health standards, facilitates training and consultation and enforces regulations to ensure that workers in the public sector are provided with safe and healthful working conditions.

FEDERAL AGENCIES WITH MAJOR INDOOR AIR RESPONSIBILITY FOR PUBLIC AND COMMERCIAL BUILDINGS

US Environmental Protection Agency

Conducts a non-regulatory indoor air quality program that emphasizes research, information dissemination, technical guidance, and training. Issues regulations and carries out other activities that affect indoor air quality under the laws for pesticides, toxic substances, and drinking water.

Public Information Center

(PM - 211B)
401 M Street, SW
Washington, DC 20460
(202) 260-2080

Distributes indoor air quality publications.

National Pesticides Telecommunications

Network National toll-free number:
1-800-858-PEST
Provides information on pesticides.

TSCA Hotline Service

(202) 554-1404

Provides information on asbestos and other toxic substances.

Occupational Safety and Health Administration

Promulgates safety and health standards, facilitates training and consultation, and enforces regulations to ensure that workers in the private sector are provided with safe and healthful working conditions. (For further information contact OSHA Regional Office.)

OSHA Regional Office

(NJ, NY, PR, VI)

OSHA Region 2
210 Varick Street, Room 670
New York, NY 10014
(212) 337-2376

National Institute for Occupational Safety and Health

Conducts research, recommends standards to the US Department of Labor, and conducts training on various issues including indoor air quality to promote safe and healthful work-places. Undertakes investigations at request of employees, employers, other federal agencies, and state and local agencies to identify and mitigate workplace problems.

Requests for Field Investigations

NIOSH

Hazard Evaluations and Technical Assistance Branch (R-9)
4676 Columbia Parkway
Cincinnati, OH 45226
(513) 841-4382

Requests for Information:

1-800-35-NIOSH
or 1-800-356-4674

EPA Regional Office

Address inquiries to the contacts in the EPA Regional Offices at the following address:

(NJ, NY, PR, VI)

EPA Region 2
26 Federal Plaza
New York, NJ 10278
(212) 264-4410 (indoor air)
(212) 264-4410 (radon)
(212) 264-6671 (asbestos)
(212) 264-6770 (NESHAP)

OTHER FEDERAL AGENCIES WITH INDOOR AIR RESPONSIBILITIES**Bonneville Power Administration**

PO Box 3621-RMRD
Portland, OR 97208
(530) 230-5475

Provides radon-resistant construction techniques, source control, and removal technology for indoor air pollutants.

Consumer Product Safety Commission

5401 Westbard Avenue
Bethesda, MD 20207
1-800-638-CPSC

Reviews complaints regarding the safety of consumer products and takes action to ensure product safety.

General Services Administration

18th and F Streets, NW
Washington, DC 20405
(202) 501-1464

Writes indoor air quality policy for Federal buildings. Provides proactive indoor air quality building assessments. Assesses complaints and provides remedial action.

US Department of Energy Office of Conservation and Renewable Energy

1000 Independence Avenue, SW, CE-43
Washington, DC 20585
(202) 586-9455

Quantifies the relationship among reduced infiltration, adequate ventilation, and acceptable indoor air quality.

US Department of Health and Human Services**Office on Smoking and Health**

National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control 1600 Clifton Road, NE
Mail Stop K50
Atlanta, GA 30333
(404) 488-5705

Disseminates information about the health effects of passive smoking and strategies for eliminating exposure to environmental tobacco smoke.

PRIVATE SECTOR CONTACTS

The private sector organizations that have information for the public on indoor air quality issues in commercial and public buildings include the following:

Building Management Associations**Association of Physical Plant Administrators of Universities and Colleges**

1446 Duke Street
Alexandria, VA 22314-3492
(703) 684-1446

Building Owners and Managers Association International

1201 New York Avenue, NW, Suite 300
Washington, DC 20005
(202) 408-2684

Institute of Real Estate Management

430 North Michigan Avenue
Chicago, IL 60611
(312) 661-1930

International Council of Shopping Centers

1199 North Fairfax Street, Suite 204
Alexandria, Va 22314
(703) 549-7404

International Facilities Management Association

Summit Tower, Suite 1710
11 Greenway Plaza
Houston, TX 77046
(713) 623-4362

National Apartment Association

1111 14th Street, NW, Suite 900
Washington, DC 20005
(202) 842-4050

National Association of Industrial and Office Parks
1215 Jefferson Davis Highway, Suite 100
Arlington, VA 22202
(703) 979-3400

**PROFESSIONAL AND STANDARD SETTING
ORGANIZATIONS**

Air and Waste Management Association
PO Box 2861
Pittsburgh, PA 15230
(412) 232-3444

Air-Conditioning and Refrigeration Institute
1501 Wilson Blvd., Suite 600
Arlington, VA 22209
(703) 524-8800

**American Conference of Governmental Industrial
Hygienists**
6500 Glenway Avenue, Build D-7
Cincinnati, OH 45211
(513) 661-7881

American Industrial Hygiene Association
PO Box 8390
345 White Pond Drive
Akron, OH 44320
(216) 873-2442

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
(215) 299-5571

**American Society of Heating, Refrigerating, and Air-
Conditioning Engineers**
1791 Tullie Circle, NE
Atlanta, GA 30329
(404) 636-8400

**National Conference of States in Building Codes and
Standards, Inc.**
505 Huntmar Park Drive, Suite 210
Herndon, VA 22070
(703) 437-0100

PRODUCT MANUFACTURERS

Adhesive and Sealant Council
1627 K Street, NW, Suite 1000
Washington, DC 20006-1707
(202) 452-1500

Asbestos Information Association
1745 Jefferson Davis Highway, Room 509
Arlington, VA 22202
(703) 979-1150

Business Council on Indoor Air Quality
1225 19th Street, Suite 300
Washington, DC 20036
(202) 775-5887

Carpet and Rug Institute
310 Holiday Avenue
Dalton, GA 30720
(404) 278-3176

Chemical Specialties Manufacturers Association
1913 I Street, NW
Washington, DC 20006
(202) 872-8110

Electric Power Research Institute
PO Box 10412
Palo Alto, CA 94303
(415) 855-2902

Formaldehyde Institute, Inc.
1330 Connecticut Avenue, NW
Washington, DC 20036
(202) 822-6757

Foundation of Wall and Ceiling Industries
1600 Cameron Street
Alexandria, VA 22314-2705
(703) 548-0374

Gas Research Institute
8600 West Bryn Mawr Avenue
Chicago, IL 60631
(312) 399-8304

National Paint and Coatings Association
1500 Rhode Island Avenue, NW
Washington, DC 20005
(202) 462-6272

**Thermal Insulation Manufacturers Association
Technical Services**
Air Handling Committee
1420 King Street
Alexandria, VA 22314
(703) 684-0474

BUILDING SERVICE ASSOCIATIONS

Air-Conditioning and Refrigeration Institute

1501 Wilson Boulevard, 6th Floor
Arlington, VA 22209
(703) 524-8800

Air-Conditioning Contractors of America

1513 16th Street, NW
Washington, DC 20036
(202) 483-9370

American Consulting Engineers Council

1015 15th Street, NW, Suite 802
Washington, DC 20005
(202) 347-7474

Associated Air Balance Council

1518 K Street, NW
Washington, DC 20005
(202) 737-0202

Association of Energy Engineers

4025 Pleasantdale Road, Suite 420
Atlanta, GA 30340
(404) 447-5083

Association of Specialists in Cleaning and Restoration International

10830 Annapolis Junction Road, Suite 312
Annapolis Junction, MD 20701
(301) 604-4411

National Air Duct Cleaners Association

1518 K Street, NW, Suite 503
Washington, DC 20005
(202) 737-2926

National Association of Power Engineers

3436 Haines Way, Suite 101
Falls Church, VA 22041
(703) 845-7055

National Energy Management Institute

601 North Fairfax Street, Suite 160
Alexandria, VA 22314
(703) 739-7100

National Environmental Balancing Bureau

1385 Piccard Drive
Rockville, MD 20850
(301) 977-3698

National Pest Control Association

8100 Oak Street
Dunn Loring, VA 22027
(703) 573-8330

Sheet Metal and Air Conditioning Contractors National Association

4201 Lafayette Center Drive
Chantilly, VA 22021
(703) 803-2980

UNIONS

AFL-CIO

Department of Occupational Safety and Health
815 16th Street, NW
Washington, DC 20006
(202) 637-5000

American Federation of Government Employees

80 F Street, NW
Washington, DC 20001
(202) 737-8700

American Federation of State, County, and Municipal Employees

1625 L Street, NW
Washington, DC 20036
(202) 429-1215

American Federation of Teachers

555 New Jersey Avenue, NW
Washington, DC 20001
(202) 879-4400

Communication Workers of America

501 3rd Street, NW
Washington, DC 20001
(202) 434-1160

International Union of Operating Engineers

1125 17th Street, NW
Washington, DC 20036
(202) 429-9100

Service Employees International Union

1313 L Street, NW
Washington, DC 20005

American Academy of Allergy and Immunology

611 East Wells Street
Milwaukee, WI 53202
(414) 272-6071

American Lung Association

or your local lung association
1740 Broadway
New York, NY 10019

Consumer Federation of America

1424 16th Street, NW, Suite 604
Washington, DC 20026

**National Center for Environmental Health
Strategies**

1100 Rural Avenue
Voorhees, NJ 08043
(609) 429-5358

National Environmental Health Association

720 South Colorado Blvd.
South Tower, Suite 970
Denver, CO 80222
(303) 756-9090

**National Foundation for the Chemically
Hypersensitive**

PO Box 9
Wrightsville Beach, NC 28480
(517) 697-3989

Occupational Health Foundation

1126 16th Street, NW
Washington, DC 20036
(202) 842-7840

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Public Employees Occupational Safety and Health (PEOSH) Program

Appendix D: Managing Buildings for Good IAQ

Division of Environmental and Occupational Health Services

April, 1997

The relationships among building owners, management, staff, and occupants are an important factor in decisions that affect indoor air quality. The objectives of the major players in these relationships may be very different. Occupants want the building to be pleasant, safe, and attractive; if they are paying tenants, they also want to get the maximum use out of the space they rent for the least cost. Building owners and management want to maintain a reputation for providing quality property at reasonable cost, but also need to derive a profit. Facility staff are often caught in the middle, trying to control operating and maintenance costs while still keeping occupants satisfied.

Regardless of the points on which they may disagree, building occupants, staff, and management share the goal of providing a healthy indoor environment. Recognition of this common goal may help avoid conflict when discussing IAQ-related policies.

Any IAQ management system will be successful only if it is organized to fit your specific building. It would not be appropriate for this document to prescribe any single approach. However, the skills associated with IAQ management activities will be identified to help building management decide who will be best able to carry them out. Education and training programs for staff and building occupants should be provided to ensure that new procedures are understood and adopted.

Managing a building for good indoor air quality involves reviewing and amending current practice (and establishing new procedures, if necessary) to:

Operate and maintain HVAC equipment

- keep all equipment and controls in proper working order
- keep interior of equipment and ductwork clean and dry

Oversee activities of staff, tenants, contractors, and other building occupants that impact indoor air quality

- smoking
- housekeeping
- building maintenance
- shipping and receiving
- pest control
- food preparation and other special uses

Maintain communications with occupants so that management will be informed of complaints about the indoor environment in a timely way

- identify building management and staff with IAQ responsibilities
- use health and safety committees

Educate staff, occupants, and contractors about their responsibilities in relation to indoor air quality

- staff training
- lease arrangements
- contracts

Identify aspects of planned projects that could affect indoor air quality and manage projects so that good air quality is maintained

- redecorating, renovation, or remodeling
- relocation of personnel or functions within the building
- new construction

DEVELOPING AN IAQ MANAGEMENT PLAN

The chart below shows the elements of an IAQ management plan. Development of the management plan involves reviewing and revising staff responsibilities so that IAQ considerations become incorporated into routine procedures.

Organizations may assign responsibility for operations, recordkeeping, purchasing, communications, planning, and policy-making in many different ways. However, the key elements of good IAQ management remain the same:

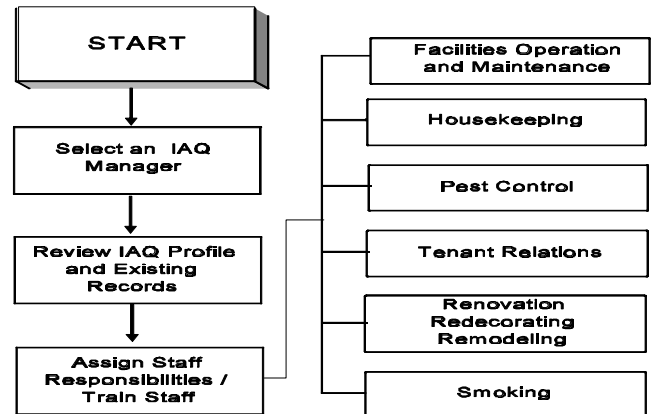
Reach an understanding of the fundamental influences that affect indoor air quality in your building by:

- becoming familiar with literature on IAQ
- keeping abreast of new information

Select an IAQ manager with:

- clearly defined responsibilities
- adequate authority and resources

Figure 1 Developing an IAQ Management Plan



Use the IAQ profile and other available information to:

- evaluate the design, operation, and usage of the building
- identify potential IAQ problem locations
- identify staff and contractors whose activities affect indoor air quality

Review and revise staff responsibilities to ensure that responsibilities that may affect indoor air quality are clearly assigned. In addition, establish lines of communication for sharing information pertaining to:

- equipment in need of repair or replacement
- plans to remodel, renovate, or redecorate
- new uses of building space or increases in occupant population
- installation of new equipment

Review standard procedures and make necessary revisions to promote good indoor air quality, such as:

- terms of contracts (e.g., pest control, leases)

- scheduling of activities that produce dust, emissions, odors
- scheduling of equipment operation, inspection, and maintenance
- specifications for supplies (e.g., cleaning products, construction materials, furnishings)
- policy regarding tobacco smoking within the building

Review the existing recordkeeping system and make necessary revisions to:

- establish a system for logging IAQ related complaints
- obtain Material Safety Data Sheets for hazardous materials used and stored in the building

Educate building staff, occupants, and contractors about their influence on indoor air quality by:

- establishing a health and safety committee
- instituting training programs as needed

IAQ problems may occur even in buildings whose owners and managers conscientiously apply the best available information to avoid such problems. Those who can demonstrate their ongoing efforts to provide a safe indoor environment are in a strong legal and ethical position if problems do arise.

SELECT AN IAQ MANAGER

IAQ management will be facilitated if one individual is given overall responsibility for IAQ. Whether or not this person is given the title of "IAQ Manager," he or she should have a good understanding of the building's structure and function and should be able to communicate with tenants, facility personnel, and building owners or their representatives about IAQ issues.

The IAQ manager's ongoing responsibilities might include:

- developing the IAQ profile
- overseeing the adoption of new procedures
- establishing a system for communicating with occupants about IAQ issues
- coordinating staff efforts that affect indoor air quality, and making sure that staff have the information (e.g., operating manuals, training) and authority to carry out their responsibilities
- reviewing all major projects in the building for their IAQ implications
- reviewing contracts and negotiating with contractors (e.g., cleaning services, pest control contractors) whose routine activities in the building could create IAQ problems
- periodically inspecting the building for indicators of IAQ problems
- managing IAQ-related records
- responding to complaints or observations regarding potential IAQ problems
- conducting an initial walkthrough investigation of any IAQ complaints

REVIEW IAQ PROFILE AND OTHER EXISTING RECORDS

If the IAQ manager was not actively involved in developing the IAQ profile, one of the first tasks will be to review the profile carefully. The manager can start by also identifying building locations with a potential for IAQ problems, staff and contractors whose activities impact indoor air quality, and other building occupants whose activities impact indoor air quality.

PRODUCTS OF THE REVIEW OF THE IAQ PROFILE AND OTHER EXISTING RECORDS

- a priority list of locations and activities within the building that will require special attention in order to prevent indoor air quality problems
- a list of staff and contractors whose responsibilities need to be included in the IAQ management plan

In addition to information from the IAQ profile, it may be helpful to review lease forms and other contractual agreements for an understanding of the respective legal responsibilities of the building management, tenants, and contractors. Incorporation of IAQ concerns into legal documents helps to ensure the use of proper materials and procedures by contractors and can help to limit the load placed on ventilation equipment by occupant activities.

ASSIGN RESPONSIBILITIES/TRAIN STAFF

The assignment of responsibilities varies widely between organizations, depending upon the routine activities to be carried out and the capabilities of the available personnel. It would not be appropriate for this document to suggest how IAQ-related responsibilities should be allocated in your organization. For example, issues of access in buildings with tenant-occupied space highlight the need for cooperation between building managers and the tenants' office managers. The building staff may be limited in its access to tenant spaces and tenants may not have access to building operations areas such as mechanical rooms, yet both tenants and building management have responsibilities for maintaining good indoor air quality.

Facility personnel are not generally trained to think about IAQ issues as they go about their work. Even though building staff may be observing events and conditions that would indicate potential problems to an experienced IAQ investigator, the staff member's attention may be directed elsewhere. As new practices are introduced to prevent indoor air quality

problems, an organized system of recordkeeping will help those practices to become part of routine operations and to "flag" decisions that could affect IAQ (e.g., renovations, new tenants). The best results can be achieved by taking time to think about the established channels of communication within your organization, so that new forms can be integrated into decision-making with minimum disruption of normal procedures.

Using information from the IAQ profile, the IAQ manager should work with staff and contractors to ensure that building operations and planning processes incorporate a concern for indoor air quality. New procedures, recordkeeping requirements, or staff training programs may be needed. (Growing interest in IAQ is stimulating government agencies and private sector organizations to develop training programs.) The flow of information between the IAQ manager and staff, occupants, and contractors is particularly important. Good indoor air quality requires prompt attention to changing conditions that could cause IAQ problems, such as installation of new equipment or furnishings, increases in occupant population, or new uses of rooms.

FACILITY OPERATION AND MAINTENANCE

Indoor air quality can be affected both by the quality of maintenance and by the materials and procedures used in operating and maintaining the building components including the HVAC system.

Facility staff who are familiar with building systems in general and with the features of their building in particular are an important resource in preventing and resolving indoor air quality problems. Facility personnel can best respond to indoor air quality concerns if they understand how their activities affect indoor air quality. It may be necessary to change existing practices or introduce new procedures in relation to:

Equipment operating schedules: Confirm that the timing of occupied and unoccupied cycles is compatible with actual occupied periods, and that the building is flushed by the ventilation system before occupants arrive. ASHRAE 62-1989 provides guidance on lead and lag times for HVAC equipment. In hot, humid climates, ventilation may be needed during long unoccupied periods to prevent mold growth.

PREVENTIVE MAINTENANCE

A HVAC system requires adequate preventive maintenance (PM), and prompt attention to repairs in order to operate correctly and provide suitable comfort conditions and good indoor air quality. The HVAC system operator(s) must have an adequate understanding of the overall system design, its intended function, and its limitations. The preventive maintenance program must be properly budgeted and implemented, not merely planned on paper.

A well-implemented PM plan will improve the functioning of the mechanical systems and usually save money when evaluated on a life-cycle basis. However, in some buildings, because of budgetary constraints, maintenance is put off until breakdowns occur or complaints arise, following the 'if it isn't broken, don't fix it' philosophy. This type of program represents a false economy and often increases the eventual cost of repairs.

Poor filter maintenance is a common example of this phenomenon. Filters that are not changed regularly can become a bed for fungal growth, sometimes allowing particles or micro-organisms to be distributed within the building. When filters become clogged, the fans use more energy to operate and move less air. If the filters are an inexpensive, low-efficiency, type that becomes clogged and then "blows out," the coils then accumulate dirt, causing another increase in energy consumption. Poor air filter efficiency and poor maintenance may cause dirt to build up in ducts and become contaminated with molds, possibly requiring an expensive-duct cleaning operation.

General elements of a PM plan include:

- periodic inspection, cleaning, and service as warranted
- adjustment and calibration of control system components
- maintenance equipment and replacement parts that are of good quality and properly selected for the intended function

Critical HVAC system components that require PM in order to maintain comfort and deliver adequate ventilation air include:

- outdoor air intake opening
- damper controls
- air filters
- drip pans
- cooling & heating coils

Controls of odors and contaminants: Maintain appropriate pressure relationships between building usage areas. Avoid recirculating air from areas that are strong sources of contaminants (e.g., smoking lounges, chemical storage areas, beauty salons). Provide adequate local exhaust for activities that produce odors, dust, or contaminants, or confine those activities to locations that are maintained under negative pressure (relative to adjacent areas). For example, loading docks are a frequent source of combustion odors. Maintain the rooms surrounding loading docks under positive pressure to prevent vehicle exhaust from being drawn into the building.

Make sure that paints, solvents, and other chemicals are stored and handled properly, with adequate (direct exhaust) ventilation provided. If local filter traps and adsorbents are used, they require regular maintenance. Have vendors provide Material Safety Data Sheets (MSDS's).

Ventilation quantities: Compare outdoor air quantities to the building design goal and local and State building codes and make adjustments as necessary. It is also informative to see how your ventilation rate compares to ASHRAE 62-1989, because that guideline was developed with the goal of preventing IAQ problems. (*Note:* Increasing ventilation quantities to meet ASHRAE guidelines may exceed the capacity of HVAC equipment to condition the air.)

HVAC equipment maintenance schedules: Inspect all equipment regularly (per recommended maintenance schedule) to ensure that it is in good condition and is operating as designed (i.e., as close to the design set points for controls as possible). Most equipment manufacturers provide recommended maintenance schedules for their products. Components that are exposed to water (e.g., drainage pans, coils, cooling towers, and humidifiers) require scrupulous maintenance to prevent microbiological growth and the entry of undesired microbiological or chemicals into the indoor airstream.

HVAC inspections: Modify the **HVAC Checklists** (reproduced in Appendix B) as necessary so that they are appropriate for inspection of the specific equipment in your building. Be thorough in conducting these inspections. Items such as small exhaust fans may operate independently from

the rest of the HVAC system and are often ignored during inspections. As equipment is added, re-moved, or replaced, document any changes in function, capacity, or operating schedule for future reference. It may also be helpful to store equipment manuals and records of equipment operation and maintenance in the same location as records of occupant complaints for easy comparison if IAQ problems arise.

Building maintenance schedules: Try to schedule maintenance activities that interfere with HVAC operation or produce odors and emissions (e.g., painting, roofing operations) so that they occur when the building is unoccupied. Inform occupants when such activities are scheduled and, if possible, use local ventilation to ensure that dust and odors are confined to the work area.

Purchasing: Review the general information provided by MSDS and request information from suppliers about the chemical emissions of materials being considered for purchase.

Note: At present there is no general system for certifying or labeling low emission products nor is there a standard procedure for building managers to use in gathering emissions data on products they are considering for purchase. Limited information on some materials such as pressed-wood products is available, and more may be expected in the future. Public and private sector organizations are working to develop product testing procedures for acceptance by such organizations as the American Society for Testing and Materials (ASTM).

Preventive maintenance management: Maintenance "indicators" are available to help facility staff determine when routine maintenance is required. For example, air filters are often neglected (sometimes due to reasons such as difficult access) and fail to receive maintenance at proper intervals. Installation of an inexpensive manometer, an instrument used to monitor the pressure loss across a filter bank, can give an immediate indication of filter condition without having to open the unit to visually observe the actual filter.

Computerized systems are available that can prompt your staff to carry out maintenance activities at the proper intervals. Some of these programs can be connected to building equipment so that a signal is transmitted to your staff if a piece of equipment malfunctions. Individual areas can be monitored for temperature, air movement, humidity, and carbon

dioxide, and new sensors are constantly entering the market. These sensors can be programmed to record data and to control multiple elements of the HVAC system.

HOUSEKEEPING

Indoor air quality complaints can arise from inadequate housekeeping that fails to remove dust and other dirt. On the other hand, cleaning materials themselves produce odors and emit a variety of chemicals.

As they work throughout your building, cleaning staff or contractors may be the first to recognize and respond to potential IAQ problems. Educate them about topics such as the following:

Cleaning schedules: Consider how cleaning activities are scheduled. Managers may want to schedule the use of some cleaning agents that introduce strong odors or contaminants during unoccupied periods. However, make sure that fumes from cleaning products are eliminated before air handling systems switch to their "unoccupied" cycles.

Purchasing: Become more familiar with the chemicals in cleaning and maintenance products and their potential toxicity. Select the safest available materials that can achieve your purpose. Review the information provided by product labels and Material Safety Data Sheets. Request information from suppliers about the chemical emissions of products being considered for purchase.

Materials handling and storage: Review the use of cleaning materials to ensure proper use and storage.

Trash disposal: Follow proper trash disposal procedures. If there is a restaurant in the building, require daily pick-up of perishable refuse. Ensure that the containers are covered, pest control is effective, and that the trash collection area is cleaned at least daily.

Shipping and receiving: Shipping and receiving areas can create indoor air quality problems regardless of the types of materials being handled. Vehicle exhaust fumes can be minimized by prohibiting idling at the loading dock. This is particularly important if the loading dock is located

upwind of outdoor air intake vents. You can also reduce drafts and pollutant entry by pressurizing interior spaces (e.g., corridors) and by keeping doors closed when they are not in use.

Pest Control: Pest control activities that depend upon the use of pesticides, involve the storage, handling, and application of materials that can have serious health effects. Common construction, maintenance practices, and occupant activities provide pests with air, moisture, food, warmth, and shelter. Caulking or plastering cracks, crevices, or holes to prevent harborage behind walls can often be more effective than pesticide application at reducing pest populations to a practical minimum.

Integrated Pest Management (IPM) is a low-cost approach to pest control based upon knowledge of the biology and behavior of pests. Adoption of an IPM program can significantly reduce the need for pesticides by eliminating conditions that provide attractive habitats for pests.

If an outside contractor is used for pest control, it is advisable to review the terms of the contract and include IPM principles where possible. The following items deserve particular attention.

Pest Control schedule: Schedule pesticide applications for unoccupied periods, if possible, so that the affected area can be flushed with ventilation air before occupants return. Pesticides should only be applied in targeted locations, with minimum treatment of exposed surfaces. They should be used in strict conformance with manufacturers' instructions and EPA labels. General periodic spraying may not be necessary. If occupants are to be present, they should be notified prior to the pesticide application. Particularly susceptible individuals could develop serious illness even though they are only minimally exposed.

Materials selection, handling, and storage: Select pesticides that are species-specific and attempt to minimize toxicity for humans and non-target, species. Ask contractors or vendors to provide EPA labels and MSDS's. Make sure that pesticides are stored and handled properly consistent with their EPA labels.

INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is a coordinated approach to pest control intended to prevent unacceptable levels of pests, while causing the least possible hazard to people, property, and the environment and using the most cost-effective means. IPM uses a combination of tactics, including sanitation, monitoring, habitat modification, and the judicious application of pesticides when absolutely necessary.

IPM methods include:

- improved sanitation (e.g., removing food from desks, cleaning)
- inspection and monitoring of pest population sites
- managing waste (e.g., keeping refuse in tight containers, locating waste containers away from building if possible)
- maintaining structures (e.g., fixing leaking pipes promptly, sealing cracks)
- adding physical barriers to pest entry and movement (e.g., screens for chimneys, doors, and windows; air curtains)
- modifying habitats (e.g., removing clutter, relocating outside light fixtures away from doors)
- using traps (e.g., light traps, snap traps, and glue boards)

Ventilation of areas where pesticides are applied: If only limited areas of the building are being treated, adjust the HVAC system so that it does not distribute contaminated air throughout the rest of the building. Consider using temporary exhaust systems to remove contaminants during the work. It may be necessary to modify HVAC system operation during and after pest control activities (e.g., running air handling units on 100% outdoor air for some period of time or running the system for several complete air exchanges before occupants re-enter the treated space).

MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheets (MSDS's) may be of limited help in identifying some products that may pose IAQ concerns. However, professional judgment and collection of additional information, may be necessary in order to make full use of the MSDS. The following table summarizes some of the issues to keep in mind when deciding whether information from MSDS's is applicable to emission sources and exposures of concern in a building.

Item	Possible Uses	Comments
Substances Covered	<ul style="list-style-type: none"> ▶ MSDS's may identify significant airborne contaminants 	<ul style="list-style-type: none"> ▶ MSDS's may not be available onsite for many products ▶ some components are listed as proprietary and are not disclosed ▶ MSDS's do not always highlight products most likely to be airborne ▶ contaminant byproducts inadvertently formed during manufacture won't always be listed
Personal Protection/ First Aid	<ul style="list-style-type: none"> ▶ may suggest precautions for conducting source inspection 	<ul style="list-style-type: none"> ▶ usually relates only to high-level, worst-case exposures in general industry
Health Effects	<ul style="list-style-type: none"> ▶ a generally presents types of health effects that may be expected primarily at high level (e.g., industrial) exposures 	<ul style="list-style-type: none"> ▶ symptoms listed may not occur at low-level concentrations found in indoor air ▶ MSDS's may not include more subtle IAQ aspects such as nuisance factors and sensitivity to mixtures
Physical Data	<ul style="list-style-type: none"> ▶ odor description may help identify sources ▶ volatility may suggest which products are likely to be airborne ▶ contaminants to expect in event of a fire or decomposition may be listed ▶ reactivity data may suggest potential problems with storage or use 	<ul style="list-style-type: none"> ▶ reference material on how to use physical data information to predict IAQ impacts may be scarce
Control Measures	<ul style="list-style-type: none"> ▶ identifies proper storage and packaging procedures ▶ identifies steps for cleanup of gross spills 	<ul style="list-style-type: none"> ▶ many office chemicals are kept in much smaller amounts than found in industrial settings ▶ spill cleanup may not eliminate airborne contamination ▶ does not specify routine emission controls

A reasonable effort should be made to collect available MSDS's during IAQ profile development. Care should be taken to consider information that is relevant to IAQ concerns. Other important indicators of how a particular product may affect IAQ are available from direct odor and dust observations, a review of work practices, and interviews with operators and occupants. The manufacturer is a good source of follow-up information on a given product (phone number should be included on each MSDS).

OCCUPANT RELATIONS

Managing occupant relations to prevent IAQ problems involves: allocating space and monitoring the use of building areas to isolate odor- and contaminant-producing activities and avoid re-entrainment; establishing a communication strategy that is responsive to complaints and provides tenants with information about their role in preventing indoor air quality problems; and modifying employee manuals or lease agreements as necessary to clarify the responsibilities of occupants and building management. A health and safety committee or joint tenant-management IAQ task force that represents all of the major interest groups in the building can be very helpful in disseminating information and fostering a cooperative approach to IAQ management.

RENOVATION, REDECORATING, AND REMODELING

Renovation, redecorating, and remodeling activities can create indoor air problems by producing dust, odors, microbiologicals and their spores, and emissions. It is difficult to prevent IAQ problems if some building areas are undergoing renovation while adjoining areas continue normal operations.

Close monitoring of renovation, redecorating, and remodeling projects is recommended. The following suggestions may be helpful:

Working with professional consultants: Communicate your concern about preventing indoor air quality problems to the engineer, architect, interior designer, or other professionals involved in the project.

Product selection: Specify products and processes that minimize odors and emissions, while maintaining adequate safety and efficacy. Review the general information provided by the product labels and MSDSs. Request information from suppliers about the chemical emissions of products being considered for purchase.

Work schedules: Schedule activities that produce dust, odors, or emissions for unoccupied periods if possible.

Isolation of work areas: Block off return registers so that contaminants are not recirculated from the demolition/construction area into adjoining areas, and

install temporary barriers to confine dust and noise. If possible, install temporary local exhaust to remove odors and contaminants, and check to confirm that the temporary ventilation system is operating as planned.

Installation of new furnishings: Ask suppliers to store new furnishings in a clean, dry, ventilated location so that volatile organic compounds will be emitted before installation. Minimize the use of adhesives during installation or specify low-emitting products. After new furnishings are installed, increase the ventilation rate to flush the area with outdoor air and dilute emissions.

SMOKING

Although there are many potential sources of indoor air pollution, both research and field studies have shown that environmental tobacco smoke (ETS) is one of the most widespread and harmful indoor air pollutants. Environmental tobacco smoke is a combination of sidestream smoke from the burning end of the cigarette, pipe, or cigar and the exhaled mainstream smoke from the smoker. ETS contains over 4,000 chemicals; 43 of these chemicals are known animal or human carcinogens. Many other chemicals in ETS are tumor promoters, tumor initiators, co-carcinogens (i.e., chemicals that are able to cause cancer when combined with another substance), or cancer precursors (i.e., compounds that can make it easier to form other carcinogenic chemicals).

In 1986, *The Health Consequences of Involuntary Smoking: A Report of the Surgeon General on Environmental Tobacco Smoke* concluded that ETS was a cause of lung cancer in healthy nonsmokers and that "the scientific case against involuntary smoking as a public health risk is more than sufficient to justify appropriate remedial action, and the goal of any remedial action must be to protect the non-smoker from environmental tobacco smoke." In the same year, the National Research Council of the National Academy of Sciences issued a report, *Environmental Tobacco Smoke: Measuring Exposures and Assessing Health Effects*, which also concluded that passive smoking increases the risk of lung cancer in adults.

In June 1991, NIOSH issued a *Current Intelligence Bulletin* (#54) on ETS in the workplace that dealt with lung cancer and other health effects. In its *Bulletin*, NIOSH stated that the weight of evidence is sufficient to conclude that ETS can cause lung cancer in non-smokers (i.e., those who inhale ETS). It recommended that the preferable method to protect non-smokers is the elimination of smoking indoors and that the alternative method is to require that smoking be permitted only in separately ventilated smoking areas. The NIOSH *Bulletin* emphasized that provision of such isolated areas should be viewed as an interim measure until ETS can be completely eliminated indoors.

Smoking areas must be separately ventilated, negatively pressurized in relation to surrounding interior spaces, and supplied with much more ventilation than non-smoking areas. The NIOSH *Bulletin* also recommends that the air from the smoking area should be exhausted directly outdoors and not recirculated within the building or vented with the general

exhaust for the building. ASHRAE Standard 62-1989 recommends that smoking areas be supplied with 60 cubic feet per minute (60 cfm) per occupant of outdoor air; the standard also recognized that using transfer air, which is pulled in from other parts of the building, to meet the standard is common practice.

Both EPA and NIOSH advise that building owners or facility managers considering the introduction of smoking restrictions should implement smoking cessation programs. In addition, employees and labor unions should be involved in the development of non-smoking policies in the workplace.

The information in this document has been reprinted from EPA document # ISBN 0-16-035918-8, *Building Air Quality, A Guide for Building Owners and Facility Managers*.

PRODUCTS OF THE ASSIGNMENT OF RESPONSIBILITIES AND REVIEW OF TRAINING

- ▶ job description and/or contracts, work procedures
- ▶ procedures for reviewing purchases of supplies, new projects, contracts, and policies in relation to indoor air quality
- ▶ smoking policy revisions, if necessary
- ▶ plans for educating occupants and training staff training in relation to indoor air quality

Sample Form

MANAGEMENT CHECKLIST

Item	Date Begun or Completed (as applicable)	Responsible Person (name, telephone)	Location ("NA" if the item is not applicable to this building)
Collect and Review Existing Records			
HVAC design data, operating instructions, and manuals			
HVAC maintenance and calibration records, testing and balancing reports			
Inventory of locations where occupancy, equipment, or building use has changed			
Inventory of complaint locations			
Conduct a Walkthrough Inspection of the Building			
List of responsible staff and/or contractors, evidence of training, and job descriptions			
Identification of areas where positive or negative pressure should be maintained			

GUIDELINES OF CARE DEVELOPED-BY TRADE ASSOCIATIONS	The following associations have developed guidelines of care that may have a direct or indirect impact on indoor air quality. These standards are described below so that building management may become aware of them. Neither EPA nor NIOSH endorse these standards.
Air Conditioning Contractors of America (ACCA)	Technical Reference Bulletin Series. Indoor air quality is one of the topics covered, in this series of technical bulletins on heating, ventilation, and air conditioning (HVAC). Bulletins can be filed in the <i>ACCA Technical Reference Notebook</i> . The Air Side Design tab of the notebook includes bulletins devoted to indoor air quality control.
Air-Conditioning and Refrigeration Institute (ARI)	Air conditioning and Refrigeration Equipment General Maintenance Guidelines for Improving the Indoor Environment (1991). General maintenance requirements for heating ventilation, air conditioning, and refrigeration (HVACR) equipment. Specific equipment/component maintenance is given for the following systems; ducts; registers/diffusers and air terminals; dampers/economizers; drain pans; air handlers; humidifiers; package terminal units; and evaporator, condenser, hydronic and economizer coils. The guidelines do not supersede any maintenance instructions that are provided by the manufacturer. In addition, the Institute has issued an <i>Indoor Air Quality Briefing Paper</i> that addresses the interactions between HVACR equipment and the quality of indoor air.
Associated Air Balance Council (AABC)	National Standards for Testing and Balancing Heating, Ventilation, and Air Conditioning Systems (1989). Establishes a minimum set of field testing standards and provides comprehensive and current data on testing and balancing HVAC systems. Chapters receiving special attention include Cooling Tower Performance Tests, Sound Measurements, Vibration Measurements, Fume Hoods, and AABC General Specifications. The book contains a complete index to the technical data provided.
National Environmental Balancing Bureau (NEBB)	Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems (1991). A "how-to" set of procedural standards that provide systematic methods for testing, adjusting, and balancing (TAB) of HVAC systems. Includes sections on TAB instruments and calibration, report forms, sample specifications, and engineering tables and charts. A valuable innovation is the "Systems Ready to Balance" start-up checklist to help organize jobs systematically. Other features include: additional engineering data; condensed duct design table /charts; hydronic design tables/charts; and pertinent HVAC equations in US and metric units.
National Pest Control Association (NPCA)	Good Practice Statements. Periodically updated, officially approved and adopted by the Association's Board of Directors, these "Good Practice Statements" are designed as guidelines for performing various services rather than standards of operation. In addition, the Association produces a self-study series for technician that covers five areas of pest control, management manuals, an encyclopedia of structural pest control, a number of specific subject matter technical manuals, and a pamphlet series.
Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)	HVAC Duct Construction Standards - Metal and Flexible (1985). Primarily for commercial and institutional work, this set of construction standards is a collection of material from earlier editions of SMACNA's low-pressure, high-pressure, flexible duct, and duct liner standards. In addition, SMACNA has published a manual entitled <i>Indoor Air Quality</i> that contains basic information on many aspects of indoor air quality and guidance on conducting building evaluations and quality audits. Other related SMACNA publications include <i>HVAC Duct Inspection Guide</i> , <i>HVAC Systems - Testing, Adjusting and Balancing</i> , and <i>HVAC Air Duct Leakage Test Manual</i> .